TABLE II

GROUP I

Years	Mathe-matics.	English	Latin	German or Greek	History	Science	Total
I	5	5	5	..	5[1]	5[2]	20
II	5	5	5	5[2]	..	5[1]	20
III	4	3	4	4	4	..	19
IV	4	3	4	4	4	..	19

GROUP 2

Years	Mathe-matics	English	French	German	History	Science	Total
I	5	5	..	..	5	5	20
II	5	5	..	5[2]	5[1]	5	20
III	4	3	4	4	4	..	19
IV	4	3	4	4[1]	4[2]	4	19

[1] First half-year.
[2] Second half-year.

MATHEMATICS

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That much of the subject-matter and many of the methods used in mathematical teaching as late as a decade ago were objectionable is a proposition accepted on every hand. That some of these defects still remain, in spite of numerous efforts to eliminate them, is all too true. That, in a few instances, educational reformers should have advocated extreme measures is not surprising. Indeed, among proposed innovations may be found pedagogical freaks, dangerous fads, and silly crazes. Not every radical departure is in the right direction. To reject new errors is as necessary as to discard old ones. To discover wherein new theories are unsound is as desirable as the appropriation of fresh truth.

In recent years there has been a well-nigh universal demand that courses in arithmetic be shortened. It is generally agreed that the time and energy devoted to this study are altogether out of proportion to the knowledge and power acquired or the uses to which these are put in after life. Whether the schoolboy is preparing for college or for citizenship, it is equally certain that, with the kind of course now in vogue, mental effort is misdirected. Much of the instruction in this fundamental branch of mathematics not only fails in fitting him for expert work in any department of business, but forever robs him of those habits of accuracy and thoroughness which proper teaching

should impart. Let it be boldly and baldly proclaimed that the crying need of today is the emphasizing of essentials with the abridgment or the omission of intricate developments—the non-essentials. It is not quantity, but quality, that counts. The value of arithmetic in the school curriculum, no matter what the point of view, is measured not so much by the amount of work done as by the manner in which it is done. It is a common complaint that the large majority of school pupils and college students are neither quick nor accurate in ordinary computations. After years spent on number the fundamental operations are not performed with ease; factoring and cancellation are often overlooked; decimals and the decimal system of notation are not appreciated. What is the matter? These and other highly important subjects have been more or less slighted and weary months given to a large mass of material beyond the mental grasp of ninety-nine out of a hundred youths. Most of the text-books contain confusing technical terms, perplexing problems in stocks and bonds, time-wasting discussions of repeating decimals, average payments, progressions, etc. There is page after page of examples relating to insurance, exchange, taxation, and banking—subjects wholly outside the range of the pupil's experience and about the real nature of which he knows little or nothing. And even if it were possible to bring these transactions within the comprehension of an inexperienced boy, what were the benefit to be derived from such a course? The average arithmetic gives far more of this kind of material than any business man ever uses. Besides, it is no more the place of a public school to make bankers than to make blacksmiths. It is not within the province of a secondary school to specialize at all. It does not exist for the purpose of manufacturing machines for the making of money or of fitting for any trade or profession.

Notwithstanding dogma and tradition, a mighty revolution is going on which is bound to result in a recasting of the work classed as arithmetic. The conscientious teacher will not be slow in catching step with this progressive movement.

What will be some of the marks of the arithmetical teaching of the future? Both the disciplinary and the practical value will be prominent, neither being sacrificed for the other. There will be earnest striving for rapidity and accuracy in the four ground processes—quickness with figures—speed in computation. This will be secured by a more complete mastery of the elements through increased drill in fundamental operations, laying proper stress on decimals, and simple ordinary fractions. It will also regard the development of the reasoning faculty as indispensable. To this end novelties, puzzles, riddles will be discarded and "all tricks to show the stretch of human brain." Problems which discourage by their complexity will be avoided as destructive of interest and prejudicial to mental growth. Mensuration will wait on concrete geometry. Cube root, compound partnership, annuities, and the like will be omitted. Interest, discount, commission, etc., will consume less time and be taught with reference to the

underlying, unifying principle. There will be more oral and analytical work The memory will no longer be burdened with unnecessary rules and useless definitions. The mind, having mastered principles, will be independent of rules. In fact definitions and rules, instead of being put conspicuously in the foreground, will follow easy illustrative examples. The metric system will find its richly-deserved place in the arithmetic of the future. The use of letters to represent numbers will be introduced early and very soon followed by the simple equation. With such teaching, superficiality will be superseded by thoroughness and positive aversion by appreciative admiration.

Having to some considerable extent anticipated algebra in the study of arithmetic, when the more systematic treatment of the former is reached, no shock of abrupt change in either matter or methods will be experienced and the continuity of the work in number will be recognized. Early in the course it will prove profitable to compare arithmetical and algebraic solutions of problems, thus throwing a world of light on the one and exhibiting the greater power and generality of the other. Both pleasure and inspiration will come from the possession of a tool which enables one to do intelligently what, otherwise would be impossible, or, at best, largely mechanical.

Many of the remarks made in regard to the teaching of arithmetic apply with equal force in the case of algebra. Progress will depend, in large measure, on speed and accuracy in performing the four fundamental operations with algebraic numbers. Readiness in all the mechanical processes must be acquired. The language of algebra must be thoroughly learned. Much attention should be given to factoring, and greater stress should be laid on the use and the theory of fractional exponents and radicals. Instead of neglecting literal equations, their reduction and solution should receive emphasis. In general, rules should not be memorized. This, of course, does not apply to certain type-forms of such frequent occurrence as that they should be committed to memory. A student should be able to write at once the product of the sum and difference of two numbers, the square of any polynomial, the quotient of the difference of like powers divided by the difference of the numbers, etc. Geometric illustration will lend interest, as in the case of the square of the sum of two numbers. Numerical illustration, too, may often be used to advantage. For instance, directing attention to the fact that the square root of nine plus the square root of sixteen is not equal to the square root of twenty-five may serve to eradicate an error sometimes made in work with radicals. But whenever such aid is invoked illustration must not be mistaken for demonstration.

The alert teacher, ever on the lookout for evidences of erroneous conceptions of number, will probably have occasion to explain that the letter x has no monopoly of the unknown, that it is not itself a number, and that any other symbol whatsoever might be used in its stead. And he will certainly have to tell somebody that to "divide through by the minus sign" is as absurd as to divide by a sign of multiplication or an interrogation point.

To successfully combat these and other errors teach thoroughly the principle involved in every operation. Skill in mechanical manipulation of symbols is necessary but not sufficient. The chief end in the study of algebra is to cultivate the reasoning faculty. And here is found its real and lasting value whether the pupil has civic duties or college privileges in view.

The elementary concepts of space are simpler than those of number and may be imparted at an early age in an informal manner by means of unprepared recitations. A child may easily acquire the notion of a circle from a variety of objects such as plates, buttons, wheels, dimes, without any attempt whatever at scientific definition or the mention of the word geometry. With a brief period once a week for several years many other common forms may be considered and some interest aroused even before systematic instruction in concrete geometry is begun. The work will now be more intensive as well as more extensive, and a suitable text-book should be used. To exclude such help at this stage would seem an unwise adherence to the Socratic method, if not, indeed, a perversion of it. In the mathematical workshop or laboratory the pupil will carry on investigations under the direction of a competent teacher. With the outlay of a few cents he can equip himself with all needed apparatus — pencil, compasses, ruler, scissors, etc. By making plane and solid figures from paper and pasteboard, drawing, cutting, measuring, folding, etc., familiarity with the simple properties of geometric magnitudes will be acquired. Thus the principal fact of geometry may be rendered evident by construction, observation, experiment, and concrete illustration, and in a way that carries conviction to the youthful mind. Whatever of mensuration is learned by this method will enable one to do with confidence born of actual, experimental knowledge what, otherwise, would be at the dictum of some rule.

The pupil having got a goodly stock of geometric ideas and having grown familiar with notions of form, demonstrative geometry will not seem a realm of the unreal. But while the transition is made under these most favorable conditions, there is a genuine transition, and there is a certain newness of means and end.

Mental muscles are now to be trained for sledge-hammer blows. The acquisition of useful knowledge is to be regarded as distinctly subordinate to mental discipline. However great the value of concrete geometry, better, far better, had it died in its infancy, than that it should supplant the strictly formal, intensely logical, sternly disciplinary treatment. As a factor in education its highest function is to serve as a basis for the study of demonstrative geometry. Here is a subject demanding close definition, precise statement, clear expression, rigorous exactness in reasoning, not tolerating vagueness, accepting nothing without proof, reaching conclusions by a logical order absolutely unassailable.

In teaching this most admirable system of exact logic, in the judgment of the writer, there should be but little, if any, departure from the rigor,

clearness, and elegance of syllogistic demonstration. Whatever may be said for the heuristic, the genetic and other methods, the Euclidean has no equal for the development and training of logical powers.

All discussion of those geometric axioms to which every ordinary mind gives immediate assent is unwise. Metaphysical perplexities should be avoided. Whether our space is hyperbolic, elliptic, or parabolic is not a present concern of a high-school pupil. The philosophy of fundamentals belongs to a much later period.

A few suggestions as to class-room work may not be inappropriate. The teacher should direct the recitation from first to last with closed book. Neatness, orderliness, and care should characterize all blackboard work. Models should not be used except to a very limited extent. Figures should represent general, rather than special, cases; if the proposition has to do with a quadrilateral, the figure of a parallelogram is likely to mislead. The statements of propositions should be carefully memorized. But it would be much more profitable, and less idiotic, to commit to memory a page in a spelling-book than a demonstration in geometry. During the course of an argument the reasons for each step should be stated, and it should be insisted that the only acceptable reasons are axioms, definitions and propositions previously established. These should be quoted, not by their numbers, but in exact, scientific language. The pupil should stand so that the whole class may see the figure, and should indicate with a pointer every part named. Undivided attention on the part of all should be required, each member of the class holding himself in readiness to answer any relevant question or to take up the demonstration at any stage. The lettering should be altered and, gradually, unlettered figures may be used, while, later, it will prove an excellent exercise to erase simple lettered figures and demonstrate from the mental image. It must not be forgotten that imagination is one of the highest and most essential qualities of a mathematical mind.

The subject of limits should be thoroughly taught. Too often its simplest theorem is glibly recited as if it had talismatic power.

Purely geometric methods, except in dealing with proportion, are very much to be preferred.

A great deal of time and effort should be devoted to original exercises. If these are well graded and selected with care, and if pupils have been trained from the outset to this kind of work, aided at first by hints and some auxiliary lines, such a course will be beneficial in the highest degree. It is unnecessary to say much about methods of attack. What is most needed is plenty of practice preceded by accurate knowledge of definitions and propositions.

The foregoing remarks have contemplated a course of study extending through three years, with an apportionment of time about as follows:

First year—Concrete geometry, 2 hours per week; arithmetic (with use of simple equation), 3 hours per week.

Second year — Demonstrative geometry (one or two books thoroughly done), 3 hours per week; algebra (slow, but sure, progress), 2 hours.

Third year — Demonstrative geometry (through plane), 2 hours; algebra (through quadratics), 2 hours.

The writer has thought best to use the space at his disposal in discussing the subjects of prime importance to the vast majority of secondary schools. As to a fourth year in solid geometry and higher algebra or trigonometry, he is persuaded that only a few are, or soon will be, in a position to handle these studies satisfactorily. It is a mistake to undertake to complete before entering college all the mathematics which some prominent educators would require for the leading baccalaureate degree. Better have lower entrance requirements and less superficiality. It is a very serious question whether in general adequate treatment of these subjects is to be had anywhere else than in college. There is no gain and much loss in attempting high requirements at the sacrifice of thoroughness. The great desideratum is a sure foundation in fundamental principles.

If the pupil is to remain in school a fourth year he should not be permitted to forget his mathematics, but by at least one period a week devoted to review or a little more advanced work his knowledge should continue fresh and become more firmly fixed in mind.

ENGLISH

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The teaching of English in secondary schools will, if properly pursued, have two leading objects: (1) to store the mind with the best thoughts; (2) to express these thoughts in the best manner. Hence, in the schedule proposed for adoption by this association, literature is to be studied every week in the course, and composition is to have equal attention; technical grammar and the technics of rhetoric and composition are to have a place in the course, as they are subjects too important to neglect; but daily practical drill in writing and almost daily reading are regarded as the chief factors of true culture in English. Again, since teachers of English differ as to the place of certain studies in the course, the schedule is a movable one, so that grammar, for example, may be placed in the first year, or the fourth, or any other, as teachers may prefer. Below will be given some remarks on methods of teaching each one of the branches of instruction in the English course.

I. LITERATURE

Among the many sensible reasons for the increase of literature in the schools is this one: most children dislike grammar; many dislike the writing of compositions; many dread rhetoric; but all like to read, and all *will* read. Naturally, then, the teaching of English classics in secondary schools should